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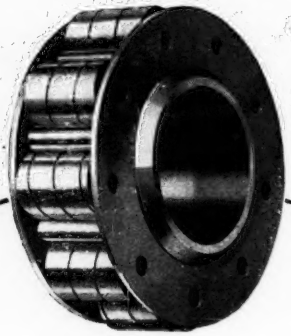

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Volume 3 OCTOBER, 1922 Number 10

Farm Implement Wheels

By **Ernest E. Einfeldt**
Master Mechanic, French & Hecht

THE wheel is of great importance. Railroad transportation, motor trucks, motor cars, farm implements, and airplanes have been made possible by the wheel. Most important of all has been the farm implement wheel which has gone through many stages of experimenting. Every type of farm implement requires a wheel to suit its own peculiarity; for instance, the binder wheel must not only carry its load but also must drive the mechanism of the binder, while the cultivator wheel needs only to carry its load.

Many of us remember when farm implements were equipped with wood wheels which gave the farmer all kinds of trouble. Spokes came loose and tires came off, climatic conditions being responsible. In most cases the steel implement wheel of today is much lighter than the wood wheel of years ago, which has been accomplished by methods of construction. Steel wheels are mostly of staggered spoke construction, the staggered spokes acting as a truss against side strain. The steel wheel also has resiliency when hard shocks, such as hitting chuck holes, meeting other road obstructions, and crossing railroad tracks are encountered. Great strength and minimum weight have been obtained by flanged tires such as used on spreader, binder, and tractor wheels. Concave and convex tires are also stronger than flats.

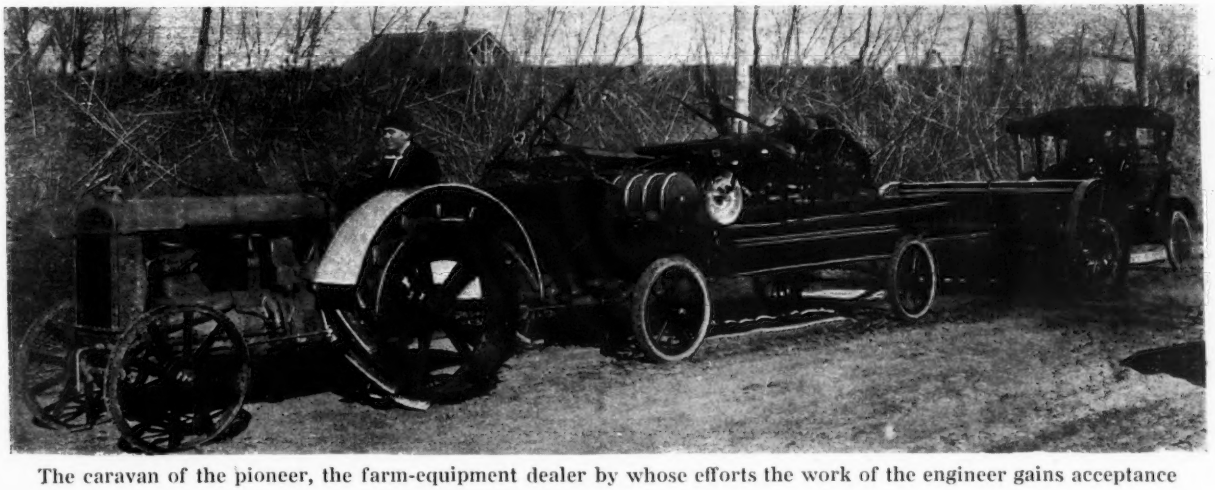
Most all implement wheels have removable boxes which may be replaced if the bearings become worn.

There are several different methods of construction. The one known as "chilled hub construction" is to secure the spokes in the tire and then cast the hub around the spokes; breakage of spokes in this type of wheel occurs where they enter the hub on account of the molten iron burning the spoke material. The removable box has not worked out to best advantage with the chilled hub. When anti-friction bearings are used in the chilled hub wheels, it is necessary to handle the completed wheel for machining the hub; for instance, a wheel forty inches in diameter would require a forty-two-inch lathe or boring mill. This extra handling cuts down production and increases costs.

Another construction is the "screwed in" spoke type of wheel, which is made in two different methods, one of which is to screw the spoke into the hub, the other to drill the hub and screw a nut inside and outside a flanged hub. By using this method the spokes soon vibrate loose; it is also necessary to use spokes of larger diameter on account of the threading reducing the diameter and weakening the spoke.

The most popular construction in the implement and tractor wheel is one which is very flexible. In it the hub is first produced, which can be of cast iron, malleable, seamless tubing, or cast steel. After the hub has been drilled or punched the spokes are forged hot into the hub by the head-and-shoulder method. This is done on special pneumatic machines. In the construction the spokes are increased in diameter where they enter the hub. As the spokes cool, shrinkage between head and shoulder secures the spokes firmly. Another great advantage is that the hub can be machined for anti-friction bearings before inserting the spokes. This can be done on fast production machines, turret lathes, or high powered drills. In the malleable and seamless tubing hub, cast iron boxes are inserted by pressed fit. Hubs for live-axle construction are mostly cast iron.

Motor trucks and motor cars are still large users of wood wheels, but history is again repeating itself, each year bringing larger quantities of trucks and pleasure cars equipped with steel wheels. The buyer demands steel wheel equipment.



The caravan of the pioneer, the farm-equipment dealer by whose efforts the work of the engineer gains acceptance

Test of a Hog House Ventilation System

By M. A. R. Kelley

Mem. A.S.A.E. Agricultural Engineer, U. S. Department of Agriculture[1]

THE test reported in this article is one of a series of tests conducted during the winter of 1920-1921 on a number of farm-building ventilating systems in different states. The object of the investigation was to determine the factors which influence the operation of barn ventilating systems. The tests were made in cooperation with the subcommittee on farm building ventilation of the American Society of Agricultural Engineers and with the assistance of several state agricultural experiment stations.[1]

It is by no means an easy problem to provide ample ventilation in farrowing houses during cold weather and at the same time maintain a comfortable temperature; in fact, it is sometimes necessary to provide artificial heat during farrowing time. While the heat may be necessary for short periods during this time, some hog men contend that too much heat is more detrimental than too little, on the ground that excessive heat tends to produce weak and less vigorous pigs. It is not the purpose of this article to discuss the need of artificial heating in hog houses as this involves a discussion of too many factors, but we have observed that it would be more economical in some cases to provide additional insulation and better construction, properly proportioned with respect to the relation between the total air space in the room and the number of hogs, than to provide an expensive heating plant which will be used only a few days during the year.

Hog houses have long been notorious for their strong odors and the farmer has become so accustomed to them that he has accepted them as a necessary evil. That these odors can be reduced materially by proper ventilation has been repeatedly proven. While there was a hog odor noticeable in the barn described in this article it was not strong. But proper ventilation in a hog barn means more than the reduction of odors.

The test reported in this article was made in a hog barn of one of the prominent hog breeders of Steel County, Minnesota, and was made during the month of December, 1920. While the winter of 1920-1921 was noted for its mildness and the temperatures during this test were not severe, it is interesting to note the results, particularly the effect of ventilation on room temperatures. Another test made a little later in a hog house at Brookings, South Dakota, and reported by R. L. Patty in "The Swine World," of March 5, 1921, showed comparable results with respect to maintenance of inside temperature.

As shown in Fig. 1, the hog barn tested was somewhat different from the conventional type of semi-monitor-roofed hog house. This barn was of the two-story or loft type which not only provides room for storage of bedding over head, but also adds to the height of the ventilating flues, thus increasing the ventilation. The view shows the north end of the hog barn with a small shed near the southwest corner. The other buildings shown are sixty or more feet from the barn. Mention is made of the small shed since it appeared to affect the efficiency of the intakes in that corner.

When the wind was strong from the northwest backdraft occurred in the intakes on the leeward side of the northeast corner of the barn. This condition was also noted in other barns tested during high winds. Further information with regard to the speed of winds when backdrafting occurred will be given in the summation of all our winter ventilation tests.

It is not necessary to record here the method of making our tests but it was in accordance with the best information available. The accompanying floor plan shows the location of instruments and the positions of intakes and outtakes.

Fig. 2 is an interior view of the barn with pens on the east side and shows the position of the intakes and outtakes. It will be noted that the bottoms of the outtake flues are slanting, causing less obstruction of the floor space. This probably affords greater efficiency than flues extending straight to the floor. The pens are arranged so as to permit the use of cross panels for dividing each side into a number of small farrowing pens.

The walls of the barn are double boarded with drop siding on the outside, with building paper on both sides of the two-by-six-inch studs, and ceiled on the inside with six-inch flooring. Two-by-six joists are used for supporting the mow floor, one-third of which was well covered with straw. This barn was built in the fall of 1920 and cost approximately $4,000.

There were fifty-four brood sows of an average weight of four hundred pounds each in the pen shown in Fig. 2. One

[1]The writer was assisted in making this test by C. S. Whitnah, of the King Ventilating Company, Owatonna, Minnesota, a member of the A.S.A.E. Subcommittee on Farm Building Ventilation.

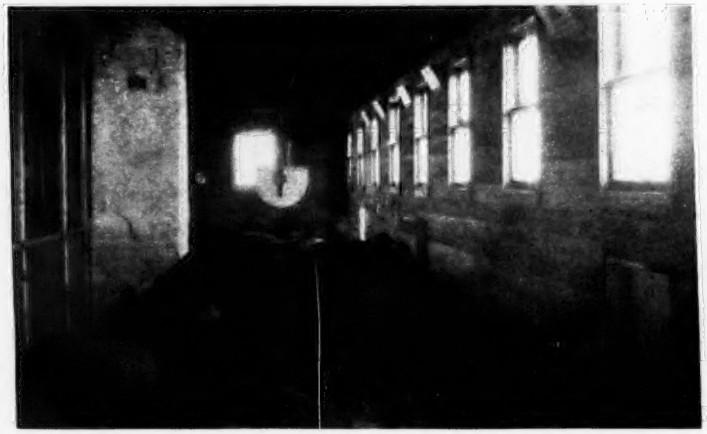
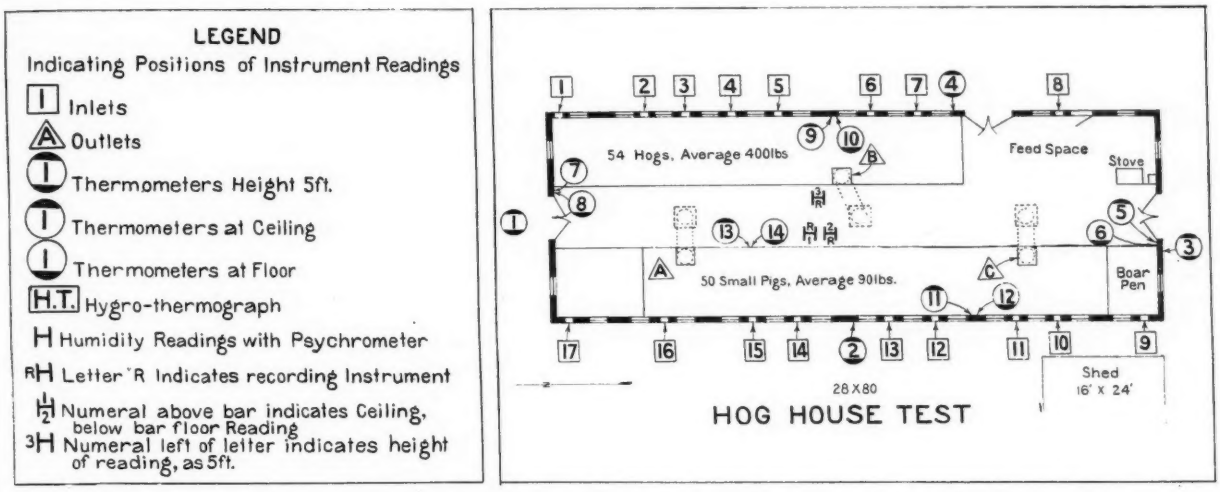


Fig. 1, at right, north end and west side of hog barn; Fig. 2, at left, interior view showing intakes and outtakes


LEGEND
Indicating Positions of Instrument Readings
I Inlets
A Outlets
T Thermometers Height 5ft.
T Thermometers at Ceiling
T Thermometers at Floor
H.T. Hygro-thermograph
H Humidity Readings with Psychrometer
RH Letter R Indicates recording Instrument
½H Numeral above bar indicates Ceiling, below bar floor Reading
3H Numeral left of letter indicates height of reading, as 5ft.
54 Hogs, Average 400lbs
Feed Space
Stove
50 Small Pigs, Average 90lbs.
Boar Pen
Shed 16' x 24'
28 X 80
HOG HOUSE TEST

Plan of barn and key to location of intakes, outtakes and test readings. Note that North is shown at left

boar and fifty pigs of ninety pounds average weight were in pens on the west side, making in all a total weight of 26,775 pounds of hogs in the barn. The average amount of heat produced by this weight of hogs, using Armsby's data[2] as a basis, would be equivalent to that given off by 104 hogs of an average weight of 300 pounds each. This is the average number of hogs that probably would be found in a farm hog house of this size. While the west side was not filled to capacity, the east side was above the average. The pen illustrated was 9 feet 4 inches wide by 62 feet long, which permits of 10 square feet of floor area for each 400-pound hog. It will be noted that this pen is filled about to its maximum capacity and probably more than is desirable for warm weather.

We wish to call attention to the comfortable position of the hogs shown in this picture. There was little tendency to "piling up." While the small pigs in the west pens huddled close together, they did not "pile up;" neither did the outside pigs try to get into the center of the pile as they often do when cold. This fact is mentioned in order to bring out the point that the pigs were reasonably comfortable under the temperature experienced during this test.

The inside dimensions of the room were 26 feet 10 inches by 78 feet 10 inches, the height being 8 feet 6 inches to the mow floor. The total volume of the room was 17,974 cubic feet, approximately 68 cubic feet per hundred pounds of live weight of hogs or 172 cubic feet per hog for 104 average sized hogs. A report of the subcommittee on farm building ventilation of the American Society of Agricultural Engineers states that a 300-pound hog should not be expected to heat more than 240 cubic feet of air space in a properly ventilated room.[3]

The accompanying table gives a summary of the ventilation test data. A glance at the table will reveal that readings were taken approximately every three hours. Since the hogs were turned out during the day (after the fourth reading) it was impossible to get a continuous set of readings and reference to the chart shows a break between readings Nos. 4 and 6. This also added to the difficulty of maintaining the temperature of the barn as the pen doors were open during the day so that the hogs were free to pass in and out and there was a consequent cooling of the barn.

By reference to the chart it will be noted that except at period 5 the volume of measured air going out was greater than measured air coming in, thus showing that there was some leakage of air through the doors, walls, and windows. The number of dilutions per hour was based on the largest circulation of measured air and in this case with reference to the amount of air going out. There was considerable change in the amount of incoming air between periods 5 and 6. This drop was due mostly to the influence of the wind, partially to the decreased wind pressure, and partially to the fact that a number of intakes were backdrafting at this time. The effective area of intakes is shown by the full line on the chart and the dotted line shows full opening of intakes. The difference between the two lines represents area of intakes which were backdrafting and acting as outtakes rather than intakes. It is interesting to note that the wind at these periods was about fourteen miles per hour. The area of intake openings was decreased at period No. 6, and yet the effect in the amount of air going out was small. It did not reduce the amount of air coming in in the same proportion as the area was reduced, since the velocity of incoming air was increased in some of the intakes. In this connection it would be well to note the velocity of the wind at the same periods.

It was possible to secure the same amount of ventilation in period No. 4 with a low wind velocity as in period No. 7 with a higher wind velocity, but with a reduced intake area. This point emphasizes the fact that we can secure good ventilation during low outside temperatures if the system is operated intelligently. As yet we have not been able to secure automatically regulated ventilation for farm buildings but progress is being made along this line. During the first night the wind was comparatively low but during the second night the average velocity of the wind was higher. A complete analysis of all factors influencing ventilation may lead to knowledge which may make it possible in the near future to give the farmer directions for operating his ventilating system. When local weather predictions are taken into consideration he will be able to regulate his system so as to obtain quite uniform conditions in his barn. Lack of intelligent operation has produced unsatisfactory conditions in many well-designed ventilation systems.

Unfortunately the sample bottles of air taken for analyses in this barn were broken before analyses could be made, hence we have no definite data with respect to the CO_2 content of the air in this barn. However, it is interesting to compare the amount of ventilation in this barn with the amount suggested by Dr. Armsby and that thought necessary by Prof. King.

Dr. Armsby, on the basis of the amount of CO_2 given off, disregarding any leakage of air and assuming other factors influencing production of CO_2 equal, has estimated that a 300-pound hog needs 776 cubic feet of air per hour to main-

[2] *Journal of Agricultural Research*, June 1, 1921; reprinted in the July and August, 1921, AGRICULTURAL ENGINEERING.

[3] "Importance of Heat in the Correct Ventilation of Hog Houses," AGRICULTURAL ENGINEERING, Vol. 1, No. 4, December, 1920.

SUMMARY OF VENTILATION TEST DATA

Period No.	Time	Air Conditions: Sq. Ft. Opening In	Sq. Ft. Opening Out	Vol. Cu. Ft. Per Min. In	Vol. Cu. Ft. Per Min. Out	Dilutions Per Hour	Wind Velocity m.p.h.	Average Temperature In	Average Temperature Out	Average Temperature Diff.	Humidity %	Barometer
1	10:10 p.m.	9.44	12.0	1146	1568	5.2	3.3	49.4	32.7	16.7	73.0	28.24
2	1:00 a.m.	9.44	12.0	944	2080	6.9	7.6	46.9	28.5	18.4	83.5	28.30
3	4.10 a.m.	9.44	12.0	983	1728	5.7	2.3	47.0	29.5	17.5	83.5	28.36
4	6:05 a.m.	9.44	12.0	1119	1508	5.0	2.9	48.3	29.0	19.3	80.5	28.36
5	8:40 p.m.	7.08	13.8	2461	2135	8.0	11.7	40.8	22.5	18.3	84.0	28.64
6	11:00 p.m.	1.53	12.5	538	2039	6.8	13.0	41.7	22.0	19.7	80.5	28.76
7	2:15 a.m.	1.29	12.0	451	1508	5.0	10.3	40.5	22.0	18.5	81.0	28.78
8	5:25 a.m.	1.29	12.0	465	1272	4.2	10.0	40.6	17.0	23.6	81.0	28.82
9	8:05 a.m.	1.29	12.0	762	1004	3.3	6.0	42.4	19.0	23.4	81.0	28.90
Averages		5.38	12.2	934	1649	5.5	7.78	44.1	24.6	19.4	80.9	28.57

tain a purity of air of 0.167 per cent of CO_2 in the room.[4] King, under the same conditions, gives 1394 cubic feet of air per hour as necessary to maintain the same degree of purity.

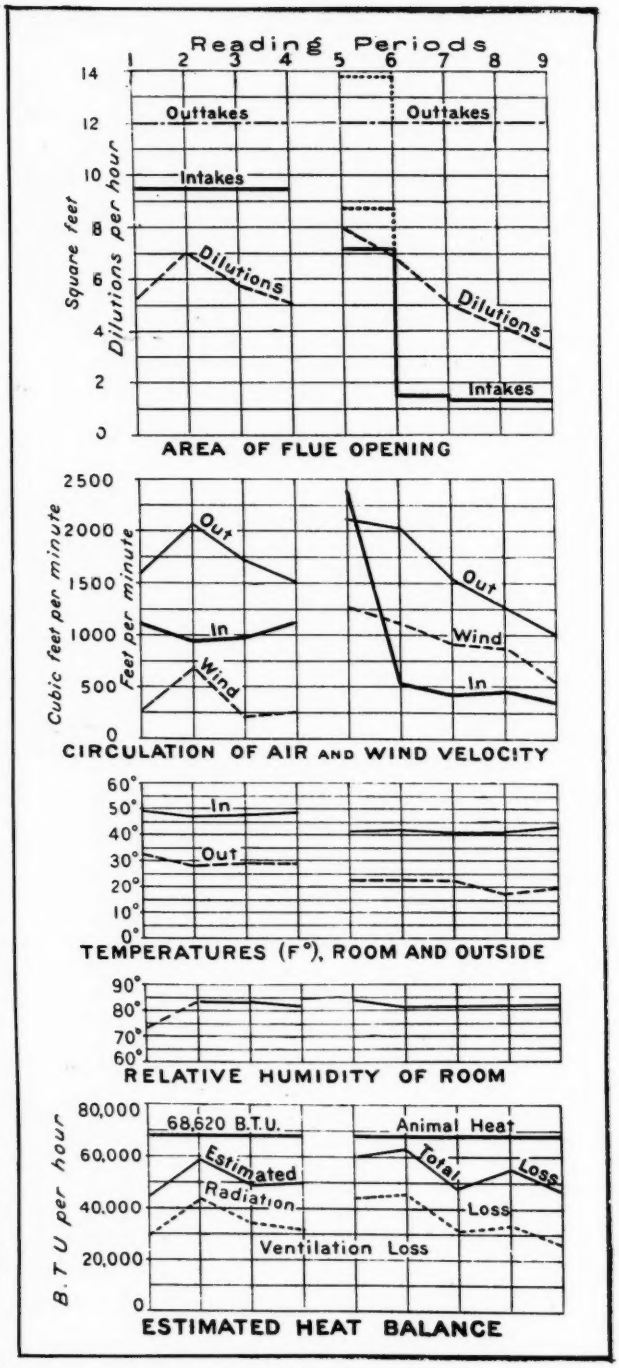
By referring to the data of the test we find that the average amount of air circulated in this barn was 951 cubic feet per head per hour based on 104 hogs of 300 pounds average weight. This, disregarding the leakage, is in excess of the estimated amount needed to offset the CO_2 produced and we may assume that the air in this barn was reasonably pure. This amount, however, is less than that recommended by King. It seems, although 776 cubic feet of air per hour is all that is necessary to obtain the desired purity of air as based on the CO_2 production, that additional circulation of air would be desirable in order to reduce the odors in the hog house.

Again comparing the conditions existing in this barn with the practices recommended by King, we find that sixteen square inches of outtake flue area is provided for each 300-pound hog in a flue twenty-four feet in height and that there is approximately twenty degrees difference in temperature between inside and outside air. King recommends a cross-sectional flue area of twenty-two square inches per hog for a flue twenty feet in height with an outside temperature of ten degrees. The conditions here are quite comparable with those recommended by King.

The average ceiling temperature experienced in this test was 46.1 degrees Fahrenheit, floor 43.2 degrees, room 44.1 degrees, and outside temperature 24.6 degrees. It will be noted that the average room temperature on the second night was less than that on the first night. The room temperature at the start of this test on the second night was less than on the previous night. After the barn was closed up there was even a slight rise in temperature. The temperature of the room for both nights was quite uniform, there being little variation in the room temperature notwithstanding a larger variation of outside temperature. The increased wind velocity and its effect on lowering the temperature of the room was partially nullified on the second night by the decreased area of intake opening.

At no time was the relative humidity high and the average maintained in this test may be considered as a good condition of room moisture.

It is generally accepted that a considerable part of the ventilation secured in farm buildings depends on the motive power derived from the temperature difference maintained between the inside and the outside air of the stable. The heat given off by animals is depended on to maintain the proper temperature in the barn. In doing this it must take care of the heat losses due to radiation, ventilation, and leakage. It is obvious that if we reduce radiation losses by better insulation and construction there will be a greater amount of heat available for maintaining the temperature in the stable and for producing ventilation. The chart shows the relation between the estimated heat production, the heat losses and the balance available for maintenance of room temperature. The amount of heat loss by ventilation from period 6 to 9 was decreased. Notwithstanding the fact that the outside temperature dropped we were able to hold the temperature of the barn at the same level. At this point it will be well to note that the areas of intakes were decreased ap-



Graphic summaries of hog barn ventilation tests

[4] See Table XVII, page 363, *Journal of Agricultural Research*, June 1 1921. See also page 177, August, 1921, AGRICULTURAL ENGINEERING.

preciably, the outtakes remaining open. Yet for this test the lowest number of dilutions per hour was a little more than three as will be seen by reference to the table previously given. In this test there was an estimated average loss of 52 per cent by ventilation of the amount of heat generated by the animals and 25.5 per cent loss by radiation. This left 22.5 per cent of the heat still available for maintenance of room temperature and for unaccountable heat losses.

It has been shown how it was possible to maintain a reasonably uniform temperature in this barn by regulating the amount of intake openings. Further study of the factors influencing and producing these conditions and the proportionate effect of each should enable us to reproduce similar conditions in other barns. Taking into consideration the local conditions, construction, etc., we should be able to determine just how much ventilation is needed to produce an acceptable degree of purity of air and percentage of moisture and still maintain a reasonable and comfortable temperature in the barn.

"Engine" Versus "Motor"

NO LEGAL contract can be binding unless there has been a "meeting of minds," as it is commonly called. A common language makes this possible, but unless care is taken to be specific confusion may even then arise.

In 1916 the Society of Automotive Engineers prepared, in cooperation with engineers and representatives of service departments of automobile companies, a list of standard names for the common automobile parts in order to eliminate confusion that existed due to the promiscuous naming of parts which had developed in the early growth of the industry.

The standard nomenclature was approved by S. A. E. members and largely followed by service managers in making up parts lists. This has resulted in saving a surprising amount of time and money in the definite and prompt making and filling of orders for parts. Certain names, the use of which was recommended in the nomenclature, were, however, not adopted as generally as might be desired, probably the most important of these being the term "engine" for designating an internal-combustion unit of the most prevalent type of automobile, the word "motor" being used to a certain extent instead.

"Motor" is the correct name for an electric unit used for changing electrical into mechanical energy, and its meaning as applied to internal-combustion engines can be understood only by the context. An electric *motor* is commonly used on gasoline automobiles in connection with the starting apparatus.

The continued misuse of the word "motor" is probably due to two factors. It is used, and correctly, to designate a moving vehicle. In addition many companies building engines were organized in the early years of the industry and included the word "motor" in their official names. As the companies prospered, the names became valuable assets and a change has been considered unwise from a business standpoint.

Nomenclature is, in a last analysis, determined by usage. Many words are common today which are in a derivative sense, entirely illogical, as well as entirely different in meaning from what they meant originally. "Electric motor" and not "electric engine" is, of course, the name for the electric unit; and the term "steam motor " is not used as applying to a prime mover. "Engine trucks" and "engine vehicles" would be equally anomalous.

There seems to be little doubt of the logic and consistency of the use of the word "engine" to denote the internal-combustion or "gas" unit of motor vehicles.

Tests of Air Cleaners for Tractor Engines

By A. H. Hoffman
Mem. A.S.A.E. Associate Professor of Agricultural Engineering, University of California

A SERIES of tests to determine dust separating efficiency, vacuum effect, and effect on maximum possible power of the motor, have just been completed by the agricultural engineering division of the college of agriculture, University of California. The twenty-six cleaners tested represent all of the more prominent makes and types. Of this number twenty-three were loaned by manufacturers in response to request, two were purchased in the open market, and one was made to specifications copying the eiderdown cleaner shown by the illustration in an article, by E. R. Wiggins, in *Chilton Tractor Journal*, issue of June 1, 1919. The list of cleaners included eight of the dry type, nine of the water type, and nine of the oil type.

In order that all cleaners might have to meet the same conditions, a standard dust was made up from ten 50-pound samples of field soils taken from ten regions in California where tractor motor wear from dust conditions is very rapid. By a pulverizing and air floating process, the dustier portions were separated from the rest. This air-floated portion constituted 99 per cent of the standard dust used, the other 1 per cent being a very fine sand. Fifty grams of this dust, bone dry, was the standard quantity used.

A small circular bristle brush revolved by a motor swept the dust into the stream of air entering the cleaner under test. The rate of feed could be varied at will by use of screws of different pitches for moving the dust feed plunger, and by varying the period of a contacting pendulum by means of which an electro-magnet and a storage battery were enabled to turn the screw.

A tractor engine of well-known make was used on which to make the tests. Absorption dynamometers enabled application of the loads.

Three standard efficiency test conditions were used:

(1) Normal load, normal speed and quick dust feed.
(2) Light load, normal speed and quick dust feed.
(3) "Service," which included variable speed, variable load, idling, quick pick-up with wide open throttle, backfiring. (At intervals during this service run, load and speed were brought to normal and readings of vacuum taken.)

Other tests were run as circumstances demanded.

Vacuum effects were measured by use of vertical U-tube manometers.

The effect of the several cleaners on power was obtained by running three series of tests for each cleaner, first one with cleaner off, than one with cleaner on, then another with cleaner off. The maximum power obtained in the second series was divided by the average of the other two. The percentage thus obtained eliminates in a measure the effect of slight variables inherent in a tractor engine.

The efficiencies, average of all tests, were by groups as follows: Oil group was most uniform, all above 96 per cent. Water group next, all above 88 per cent. Dry group third, scattered from 42.7 to 99.4 per cent.

The vacuum effect for 150 grams of dust fed in was found to be below 10 inches of water for twenty-one of the twenty-six cleaners. One, due to a defect in construction (to be remedied in the later models), shot the vacuum up to such a height that it wrecked the "absolute cleaner" designed to catch the dust lost by the cleaner under test.

The effect on power of the engine was found to be negligibly small for the average of each group, and in general for each cleaner tested so small as to render the result inconclusive without prohibitive members of reruns.

A bulletin has been prepared and is soon to be published giving a full report of the tests.

Agricultural Engineering Development

A Review of the Activities and Recent Progress in the Field of Agricultural Engineering Investigation, Experimentation and Research

Edited by **R. W. Trullinger**
Mem. A.S.A.E. Specialist in Rural Engineering, Office of Experiment Stations, U. S. Department of Agriculture

REPORT ON EXPERIMENTAL INVESTIGATIONS ON THE USE OF ALUMINUM SULPHATE ON ALKALI LAND ON RECLAMATION SERVICE PROJECTS, C. S. Scofield. [Reclamation Record, (U. S.) Washington, D. C., 13(1922), No. 1, pp. 4-5.] Studies are briefly reported which showed that alkali soils which have become impervious to water due to the presence of gelatinous silicates may be reclaimed by the use of aluminum sulphate. It was found that when applied to an alkaline soil it neutralizes the alkalinity through the formation of an insoluble aluminum silicate, the sodium of sodium silicates uniting with the sulphate of the aluminum sulphate and remaining in solution as a neutral salt which may be leached out by heavy irrigations.

Applications at the rate of two tons per acre showed a very beneficial effect on the permeability of the soil. Where the soil is very fine, such as clay, applications as small as from two to three tons per acre improved the permeability, but did not change the character of the soil as to its hardness or drying. The physical condition of this soil was improved when as much as ten tons per acre were used. This is taken to indicate that heavy applications of aluminum sulphate have greatly improved the tilth of alkaline clay soils.

STRENGTH OF MATERIALS, A. Morley. [London and New York, Longmans, Green & Company, 1920. pp. IX+555, figs. 268.] This book is written for both engineering students and practicing engineers. In many sections well established lines have been followed but numerous special features are presented. For instance, the different theories of elastic strength are explained and subsequently throughout the book the different formulas to which they lead in cases of compound stress are pointed out. Considerable use is made of the method of finding beam deflections from the moment of the area of the bending moment diagram. Other subjects treated which have hitherto received scant attention include the strength of rotating disks and cylinders, the bending of curved bars with application to hooks, and links, the strength of unstayed flat plates, and the stresses and instability arising from certain speeds of running machinery. Other subjects dealt with are mechanical properties of metals, resilience and fluctuating stress; theory of bending; stresses in beams; built-in and continuous beams; secondary effects of bending, direct and bending stresses; twisting; testing machines, apparatus, and methods; special tests; and special materials.

THE 1915-1916 TEST PAINT FENCE, W. T. Pearce, E. V. Ladd, and H. A. Kelly. [North Dakota Agricultural College, Regulatory Division, Special Bulletin, New Series, Agricultural College, North Dakota, 1(1922), No. 4, pp. 91, figs. 6.] Studies conducted in connection with the paint regulatory work at the North Dakota Agricultural College are reported. Fences for testing paint were constructed in 1915 and 1916, each section of which consists of three panels of six clapboards each. Two paint tests were made on each panel. The fences face east and west and are made of a fair grade of white pine. All of the paints tested were white in color. The pigments used were ground in the mills in the experimental paint laboratory of the college. Raw linseed oil was used in all cases except those in which oil tests were conducted when the pigment was ground in the oil that was to be tested. The oils used in the tests were raw linseed, bleached Menhaden, raw China wood, filtered Perilla, raw soy bean, raw cottonseed, and raw corn oils.

In pigment tests it was found that the replacement of basic carbonate white lead by zinc oxid caused no very bad effects up to 20 per cent. The 30 per cent replacement caused bad cracking within five years and left a poor repainting surface. The still larger replacement of basic carbonate by zinc oxid caused bad cracking and scaling within three years. A similar replacement of basic sulphate white lead by zinc oxid produced about the same effect when failures caused by poor wood were eliminated. Mixtures of basic carbonate white lead and basic sulphate white lead gave fully as satisfactory results as the pigments used separately. The substitution of as little as 15 per cent of any of the inerts in paints containing single lead pigments and mixtures of lead and zinc pigments caused very bad scaling and produced a surface wholly unfit for repainting. No differences were found in the comparative values of red lead, basic carbonate white lead, and basic sulphate white lead for priming coats for typical single and mixed pigment paints. No bad effects were noted on basic carbonate white lead when lead acetate was present in amounts less than 5 per cent.

In oil tests no differences were found in the behaviors of raw and treated linseed oils sufficient to warrant the drawing of any preferential conclusions. In the cases where different vegetable oils were used, raw linseed, filtered Perilla, raw China wood, and Menhaden oils gave good service, soy bean oil gave fair service, and corn and cottonseed oils poor service.

In the tests of driers only very slight differences were noted and no conclusions are drawn.

Data are also presented on reduction tests in which various reductions were made for the priming coat using typical single and mixed pigment paints. No conclusions are drawn.

REPORT ON THE DESIGN, CONSTRUCTION, AND LIFE OF METAL FLUMES, J. Hinds. [Reclamation Record, Washington, D. C. (U. S.), 13(1922), No. 4, pp. 65-72.] The results of a questionnaire on the design, construction, and life of metal flumes at six projects of the U. S. Reclamation Service are tabulated and discussed.

The data indicate that metal sheets galvanized, manufactured, installed, and maintained as were the earlier metal flumes will last under average conditions from ten to twelve years. No data are available as to the weight of galvanizing on these old sheets, but they probably carried not more than 1.5 ounces per square foot. The later flumes with heavier coatings and with more careful painting and maintenance may be expected to show a materially longer life.

There appears to be no appreciable difference in the last-

ing qualities of the various brands of iron and steel used for flume sheets. Rough interior flumes appear to deteriorate more rapidly than smooth flumes due to disturbances at joints. Light silt in suspension does not in all cases seriously erode the flume sheets, but heavier particles may destroy the sheets in a comparatively short time. Careful consideration should be given in designing flumes to possible future increase in canal capacity and to the size of washers and shoes.

The present type of concrete footing is generally satisfactory. The size of footing should be increased for soft soils, and special care should be taken to make footings in seeped locations resistant to alkali. Trestle timbers should be of ample size and should be protected with paint or creosote. Posts are liable to rot at the bottom.

Sheets should be painted with a coat of water-gas tar, followed by one or two coats of coal tar, before the galvanizing is destroyed, and a coat of coal tar should thereafter be maintained permanently on the sheets by repainting at intervals of from one to three years.

A SMALL GRAIN NURSERY THRESHER, O. F. Jensen and M. E. Olson. [*Journal of the American Society of Agronomy*, Albany, New York, 14(1922), No. 4, pp. 110-112, fig. 1.] A small thresher is described and diagrammatically illustrated which was designed at the Iowa experiment station to avoid the labor of threshing by hand a large number of grain samples from yard square or similar areas used in obtaining plat yields from outlying fertility and crop production experiments.

DRAINAGE AND SANITATION, E. H. Blake. [London: B. T. Batsford, Ltd., 1920, 2. ed., pp. XII+519, figs. 379.] This is the second edition of this book, the purpose of which is to give practical exposition of the conditions vital to healthy buildings, their surroundings and construction, and their ventilation, heating, lighting, water, and waste services. Considerable space is devoted to water supplies and sewage purification and disposal.

THE EFFECT OF ALKALI ON PORTLAND CEMENT, K. Steik. [Wyoming Station, Laramie, Circular 16(1922), pp. (4) figs. 2.] This circular summarizes the results of several years of study of the subject at the station. It has been found that the decrease of strength of cement in solutions of the salts which make up alkali is comparatively slow. The rate of disintegration depends to a certain extent upon the salts present in solution, their concentration, and upon the proportion of cement in the concrete. Mortars containing lesser quantities of cement disintegrate in correspondingly shorter periods of time. The bad effect of alkali does not become evident for some time after the concrete has been placed in solutions thereof.

Of the various salts which might be present in the alkali, magnesium chlorid has the greatest disintegrating effect upon concrete, followed in order by sodium sulphate and magnesium sulphate. The presence of sodium chlorid increases the harmful effect of the sulphates, while sodium chlorid alone has a very slight effect if any. Sodium carbonate retards the action of sulphates. Solutions of calcium sulphate showed no bad effects during the extent of the experiments.

In general the decrease of the tensile strength of concrete is more rapid than that of the compressive strength under the action of alkali. The age of cement or concrete before it comes into contact with solutions of alkali does not seem to have a great effect upon the rate of disintegration.

The effect of alkali upon the appearance of concrete depends to a certain extent upon its cement content. In actual practice it has been observed that the concrete in contact with alkali disintegrates much faster than could be expected on the basis of laboratory experiments. After concrete has been placed the action of alkali is augmented by changes in temperature, freezing and thawing, vegetation, and insects.

RECENT RESEARCH WORK ON THE INTERNAL COMBUSTION ENGINE, H. R. Ricardo. [*Journal Society of Automotive Engineers*, New York, 10(1922), No. 5, pp. 305-336, 347, figs. 42.] The author describes the research work on the internal-combustion engine conducted recently in his laboratory in England, and presents his deductions thereform, based upon an analysis of the evidence obtained to date. Fuels are discussed at length under the headings of detonation, latent heat of evaporation, and mean volatility.

It has been found that detonation has very little connection with the temperature of compression but is closely dependent upon the compression pressure. It is concluded that the pressure controls the initial rate of burning and, therefore, the tendency to detonate. The influence of the nature of the fuel upon detonation is discussed, including comment upon the benefits derived from using weak fuel mixtures. Turbulence is also discussed with reference to combustion chamber design.

The paper is supplemented by nine appendixes which include discussions of mechanical efficiency, piston experiments, air measurement, the total internal energy of the working fluid over a wide range of temperature, the influence of compression ratio upon power output and efficiency, the influence of cylinder size upon performance, the influence of cylinder temperature on power output, the distribution of heat in a high speed internal-combustion engine, and the efficiency of a single-cylinder engine under reduced loads.

THE BORDER METHOD OF IRRIGATION, S. Fortier. [U. S. Department of Agriculture, Washington, D. C., Farmers Bulletin 1243(1922), pp. 41, figs. 34.] This bulletin describes the border method of irrigation, gives practical information as to its proper use, and describes practice in Arizona, Nevada, Oregon, Idaho, California, and southwestern Texas. It is stated that a smooth, regular surface having a slope in one direction of about 2.5 inches to the hundred feet may be regarded as ideal for the border method of irrigation. The most favorable soil for borders is a free-working loam several feet deep, underlaid by a more or less impervious subsoil.

Considerable tabular working data are presented, together with diagrammatic illustrations and descriptions of necessary structures and equipment. Methods of preparing the land for border irrigation are also described.

INDUSTRIAL TIMBER RESEARCH ABROAD AND IN SOUTH AFRICA, I-VII. N. B. Eckbo. [*South African Journal of Industries*, Pretoria, 4(1921), Nos. 6, pp. 534-539; 8, pp. 737-744; 9, pp. 778-787; 10, pp. 847-854; 11, pp. 896-904; 5(1922), No. 2, pp. 57-65; 3, pp. 116-121, figs. 31.] The first article of this series deals with forest research institutions in the United States, India, Canada, Australia, and England. The other numbers of the series are devoted to data on processes and apparatus used in the seasoning of South African woods, together with tests of the physical and mechanical properties of certain woods after seasoning. In connection with the preparation of practicable seasoning schedules it has been found that woods of varying dimensions should be given individual treatment according to size. In general wood is considered to be seasoned when it does not shrink, warp, or split in use except under the influence of seasonal changes. If wood is uniformly dry and free from stresses, the two principal causes for shrinkage, warping, and splitting are considered to have been removed. The experiments have indicated that wood seasoned to 7 per cent moisture content by weight is fairly certain to give satisfaction.

STRESSES IN CONCRETE DRAIN TILE, J. A. Wise. [*Engineering and Contracting*, Chicago, 57(1922), No. 19, pp. 441-442, figs. 2.] In a contribution from the Bureau of Public Roads, U. S. Department of Agriculture, a mathematical analysis is presented of the stresses in concrete drain tile under load in a trench. The analysis indicates that the safe load per linear foot on such tile is greater than that allowed by the specifications of the American Society of Testing Materials.

GAS MADE BY CARBONIZING STRAW, H. E. Roethe. [*Gas Age-Record*, Chicago, 49(1922), No. 3, pp. 75-76, figs. 2.] In a contribution from the Bureau of Chemistry, U. S. Department of Agriculture, a description is given of the process and apparatus used at the Arlington, Virginia, experiment station for the production of combustible gas by the destructive distillation of straw and similar materials. The apparatus consists of a cylindrical sheet steel retort, accommodating about two hundred pounds of unbaled straw, a cylindrical sheet steel scrubber, and a steel water chamber gasometer for storage of about one hundred cubic foot capacity.

It has been found that gas begins to come off when a temperature of about 200 degrees Centimeter (392 degrees Fahrenheit) is reached, with a maximum production between temperatures of 500 and 600 degrees Centimeter. After the initial production of gas the carbonizing process can be continued, using as fuel a portion of the gas already generated. It is stated that one ton of sun-dried wheat straw produces approximately 10,000 cubic feet of purified gas, from 600 to 650 pounds of carbon residue, and about 10 gallons of tarry liquid. The gas has a calorific value of about 400 B. t. u. per cubic foot, burns with a blue flame, and has a slight odor. The combustible constituents of the gas are carbon monoxid, methane, and hydrogen.

ORIGINAL IMPROVEMENT IN WINDMILLS, M. Conti. [Revista de la Facultad de Agronomia y Veterinaria. Buenos Aires, 3(1921), No. 3, pp. 294-306, figs. 5.] Studies conducted at the experimental institute of mechanical agriculture of Argentina are reported, which resulted in the development of an improved windmill adapted for the operation of a vertical double-acting plunger pump. The essential features of this apparatus are back gearing fitted with two sets of cranks, each operating a plunger rod, one contained within the other. This permits the simultaneous operation of two plungers within a single cylinder moving in opposite directions and both acting as suction and forcing plungers at alternate periods.

Tests of the capacity of this apparatus showed that at a speed of as high as 22 strokes per minute the amount of water pumped was increased about 60 per cent over the amount pumped by ordinary single-acting apparatus.

Tests with an absorption dynamometer to determine the power development and consumption of such an outfit are also briefly reported.

DISTRIBUTION OF WHEEL LOAD ON PAVEMENT SECTIONS, H. F. Clemmer and C. A. Hogentogler. [*Engineering and Contracting*, Chicago, 58(1922), No. 1, pp. 5-9, figs. 5.]

The partial results of studies, conducted by the Illinois Division of Highways in cooperation with the U. S. Department of Agriculture, to determine the deflections of various road surfaces and corresponding pressures delivered to the subgrade during the passage of heavy motor truck wheels, are reported.

The behavior of corners adjacent to joints was also observed. Types of pavement studied were monolithic and semimonolithic brick, concrete, and bituminous filled brick on macadam base.

It was found that after initial pressure was applied the soil had a more or less definite bearing value, slightly greater than one pound per square inch for 0.01 inch deformation. The supporting value of the soil was apparently less in March than in either August or October. The support under a rigid surface was extremely variable, indications being that the surface rests on small mounds of the subgrade, having little or no support in other areas. The condition of least support was found under the corners of sections. This support was improved by traffic action.

The distance through which the influence of the load was felt or an 8-inch macadam base was much less than that on an 8-inch concrete, while the corresponding pressure on the former was about five times as great as on the latter, indicating that a soil of much higher supporting value is required for a pavement on an 8-inch rolled stone base than is required for an 8-inch rigid type of pavement. The pressure exerted on the subgrade could be reduced by increasing the thickness of the rolled stone base.

The effect of temperature change was very noticeable in rigid pavements, causing both warping and longitudinal expansion and contraction. The effect of this temperature change was least in two joints, one between two monolithic sections and one between a monolithic and concrete section.

The deflection of an independent corner was about thirteen times and that of a confined corner about six and one-half times that found at the center of the slab, indicating that the corner is the part of the slab which most deserves investigation. Neither the pressures nor the deflection as observed at corners varied directly with the magnitude of the load. Considerable movement can occur between the edges of adjacent slabs when there is not perfect contact between them, this movement being the cause possibly of shattering the edge of feathering about the joint. This movement is slightly increased by traffic. If perfect contact can be secured between adjacent edges of slabs, all movements between them will be eliminated, the deflections will be lessened, and the effect of warping between night and day will be considerably reduced.

These results are taken to indicate that every effort should be made to devise means by which sections of pavement can be so tied together that movement between them will be eliminated, or in the absence of connection between sections at joints special designs should be used for increasing the resistance of the corners.

PROGRESS IN DUST-EXPLOSION PREVENTION, D. J. Price. [*Chemical and Metallurgical Engineering*, New York, 26(1922), No. 26, pp. 1203-1206.]

In a contribution from the U. S. Department of Agriculture a summary is given of the losses resulting from dust explosions in flour mills, grain elevators, cereal and feed mills, and other dusty industries during the past forty-five years.

It is stated that a total of two hundred and forty-two dust explosions in industrial plants in the United States and foreign countries has been reported to the department. In fifty-two of these explosions three hundred and seventy-nine lives were lost, and in sixty-nine of them six hundred and fifty-one persons were injured. The total money loss in one hundred and ten explosions from which figures are available was approximately $3,000,000.

Preventive measures are discussed briefly.

WHEN PRESERVATIVE TREATMENT OF WOOD IS AN ECONOMY. [*Engineering and Contracting*, Chicago, 57(1922), No. 20, p. 466.] In a contribution from the forest service of the U. S. Department of Agriculture, tabular data are given to enable the timber user to compute the relative annual cost of maintaining treated and untreated timbers, provided he knows the average life and cost in place of each.

HYDRAULICS OF PIPE LINES, W. F. Durand. [New York: D. Van Nostrand Co., 1921, pp. 271, figs. 134.] This is one of the Glasgow series of text books of civil engineering, edited by G. Moncur. It gives a technical discussion of the more important hydraulic problems which arise in connection with pipe lines and pipe-line flow. Chapter I presents briefly the elementary principles relating to pipe-line flow, with some special emphasis on pipe friction and secondary losses due to miscellaneous turbulence. Chapter II deals with surge, and Chapter III deals with the analytical details of water ram or shock. Chapter IV discusses stresses in pipe lines due either to static pressure or conditions of flow. Chapter V presents descriptive and structural material relating particularly to materials of construction, joints, fittings, fastenings, etc. Chapter VI briefly discusses pipe lines for the conveyance of viscous fluids.

EQUIPPING AN ORCHARD SPRAY MACHINE FOR USE IN ALFALFA FIELDS, C. Wakeland. [Idaho Agricultural College Extension Circular 25(1922), pp. 4, figs. 4.]

Brief practical information is given regarding the equipment of an orchard spraying machine in order that it may be used for the spraying of alfalfa. A practical spraying strainer is also described and diagrammatically illustrated.

RATING CURVES FOR CANAL HEAD GATES, J. Hinds. [*Reclamation Record* (U. S.), Washington, D. C. 13(1922), No. 5, pp. 98-99, figs. 3.]

A brief mathematical analysis of the flow of water through orifices is given, together with curves showing the theoretical and actual values of the coefficient of discharge, corresponding to the net drop in feet, and a set of rating curves for a 3-by-2-foot outlet, showing discharges in cubic feet per second for different net drops and heights of opening.

POWER FARMING AND SUBSOILING DEMONSTRATION. [*Implement and Machinery Review*, London, 48(1922), No. 565, pp. 69-71, figs. 6.] The results of a demonstration of a number of new implements for plowing and subsoiling are briefly presented. The implements demonstrated include subsoilers, mole drain plows, pitch pole drags, self-lifting harrows and cultivators, roller packers, and a tree puller.

QUANTITIES OF MATERIAL FOR CONCRETE, D. A. Abrams and S. Walker. [Lewis Institute of Structural Materials Research Laboratory Bulletin, Chicago, 9(1921), pp. 21.]

Tables of proportions and quantities of material for concretes of compressive strengths, varying from 1,500 to 4,000 pounds per square inch, are presented in this bulletin. This data constitutes a resume of the results of a large number of laboratory investigations.

AGGREGATE STRENGTH NO MEASURE OF CONCRETE STRENGTH, F. E. Giesecke. [*Engineering News-Record*, 88(1922), No. 26, pp. 1090, 1091, figs. 2.]

Studies conducted at the University of Texas on the subject, which included 28-day and 3-month tests, are reported.

The course aggregates studied covered practically the entire range from the hardest to the softest aggregates available in Texas for concrete construction. The series consisted of three hundred test specimens, including six different aggregates and five different proportions of cement for each aggregate.

It was found that, for the materials tested and for the proportions of cement ordinarily employed in practice, the strength of concrete varies only slightly with the strength of its coarse aggregate. For very rich mixes and high ages the strength increased slightly with the strength of the coarse aggregate, but for ordinary mixes and an age of twenty-eight days the strength of concrete made with comparatively weak limestone aggregate was as high or higher than that of similar concrete made with the strong igneous rock aggregates.

ALKALI ATTACK ON CONCRETE ROADS AND BUILDING BRICK, I. Furlong. [*Engineering News-Record*, New York. 89(1922), No. 2, pp. 64-67, figs. 7.]

In a contribution from the U. S. Bureau of Standards, the results of a study on disintegration of concrete roads and building brick in the rice field country of Glenn County, California, are presented.

It was found that where seepage into depressions has been the heaviest the alkali deposits are the most abundant and the degree of highway concrete disintegration is a function of the amount of alkali in contact. In laboratory experiments with test specimens containing aggregates identical with those employed in the building of the Glenn County highway, the deleterious effects of the alkali were reproduced on such aggregates. In the range studied, the leaner mixes, when subjected to alternate wetting and drying in alkali water, yielded to the attack of alkali more rapidly and completely than the richer mixes. Under no conditions of experimentation with unprotected concrete was entire immunity to alkali water established.

The principal alkali found throughout the district is sodium sulphate, though in some places the concentration of magnesium sulphate reaches proportions worth considering. Whatever harm attributed to alkali that has been done to the highway or brick buildings in the affected region is considered to be due to a large extent to the water-soluble sulphates.

In a study of the disintegration of brick in the region, it was attempted to determine the relation of quality of brick to susceptibility to alkali attack. The bricks used were manufactured from a local raw material consisting of a natural mixture of about one part clay to three parts of sand. The alkali content of the average material from the so called clay beds was about one per cent, with sodium sulphate predominating. The outstanding difference and conspicuously new phase found in the brick but not in the parent clay was water-soluble silica. This is attributed, however, to reaction during the burning of the brick, resulting from the fusion of alkali with water-insoluble silica. A field study of bricks in the affected area, which were apparently immune to disintegration in any form, showed that they had been more thoroughly burned than the disintegrated brick, resulting in a sealed condition with reference to percolating waters. These results are taken to indicate that porous brick disintegrate under alkali attacks much faster than dense nonporous brick.

CHARACTERISTICS OF CONCRETE BRICK MASONRY, H. A. Davis. [*Concrete* (Detroit), 21(1922), No. 1, pp. 10-13, figs. 10.]

Studies conducted at Columbia University on forty-five concrete brick piers, composed of wet mixed concrete brick of thirteen different mixtures, in comparison to twelve piers built in the same manner of three brands of Hudson River clay common brick, are reported.

It is concluded that specifications for concrete brick for building purposes should recognize the fact that the ratio of the compressive strength of the masonry to the compressive strength of the individual brick is considerably higher and varies with the compressive strength of brick in the case of wet mixed concrete brick, while this ratio is fairly constant for clay brick. This is taken to indicate that to produce masonry of the same strength, the strength requirements of individual brick would be considerably lower in the case of wet mixed concrete brick than for clay brick.

RETURN FLOW WATER FROM IRRIGATION DEVELOPMENTS, R. I. Meeker. [*Engineering News-Record*, New York, 89(1922), No. 3, pp. 105-108.]

Studies are reported which show that ordinarily fifty per cent of the water diverted for irrigation purposes becomes a source of return flow.

Annual return flows of from thirty-five to sixty-five per cent of the river flow diverted were measured for large compact irrigated areas. In the South Platte tributary valleys in Colorado, where 1,100,000 acres are irrigated, return flow was found to amount to 1,000,000 acre-foot annually. In the Cache la Poudre Valley, where irrigation is intensive and 250,000 acres are irrigated, the annual return flow is 130,000 acre-foot, or about 0.5 acre-foot per acre. In the North Platte Valley of Nebraska, where water is plentiful, the annual returns from 250,000 acres are 1.6 acre-foot per acre. Annual drainage returns on two Colorado projects of 5,000 and 30,000 acres fell close to one acre-foot per acre.

It was found that monthly returns throughout the year are not constant. The return is maximum during the summer and fall months and minimum during the winter and spring.

It is concluded that from fifty to sixty per cent of the return flow under natural or artificial drainage occurs during the irrigation season and is available for re-use.

HOW TO PROLONG THE LIFE OF OILS AND ENGINES. W. B. Jones. [*Power Farming*, St. Joseph, Mich., 31(1922), No. 7, pp. 7, 8, 13, 14, figs. 2.]

This is a comprehensive discussion of the ways in which wear occurs in an engine, how lubrication prevents it, and the requirements of effective lubrication.

The conclusion is drawn that long engine life and freedom from repair expense depend upon (1) maintaining continuously a film of oil between the working parts, (2) employing oil of such a grade and keeping it sufficiently free from dilution that the working pressure cannot break the film and cause metal-to-metal contact, and (3) keeping the oil film free from solid particles of such size and character as to bridge the thickness of the oil film and cause a cutting action on the bearing surfaces.

A system for continuous reclamation of engine oil is briefly described.

NEW METHOD PROPOSED OF ARRIVING AT HEAT LOSSES DUE TO WIND, H. M. Hart. [*Heating and Ventilating Magazine*, 19(1922), No. 6, pp. 31, 32, fig. 1.]

A new method of arriving at heat losses due to wind for use in the designing of buildings is briefly suggested, which is based on U. S. D. A. Weather Bureau records of wind velocities and directions during cold spells. Tabular and graphic data are included.

RESULTS OF HEAVY TRAFFIC ON PITTSBURG TEST ROAD. [*Engineering News-Record*, New York, 88(1922), No. 26, pp. 1066-1069, figs. 4.]

The results obtained from the test road at Pittsburg, California, up to January 28, 1922, are reported.

Owing to failures of four of the thirteen sections, the tests were temporarily suspended to permit replacements. Studies of the subgrades of the failing sections showed that thorough rolling of the sprinkled adobe subgrade, layer by layer, compacted it to such an extent that, after being flooded for three months, horizontal percolation was less than one foot and vertical percolation less than two feet. The edges and corners of the concrete slab, particularly at construction joints and transverse cracks where there may be some deflection under load, were found to be the weaker portions and ordinarily were the first to fall under heavy loads or adverse subgrade conditions.

It is concluded that because of the exclusive deflection and corresponding destructive effect caused by impact a greater percentage of the time and money spent on pavements should be devoted to obtaining a perfectly smooth surface, particularly at construction joints.

A truck moving over a pavement was found to produce wave motion tending to lift the slab just in front of the deflection caused by the front wheels. A five-inch slab after deflecting under a loaded five-ton truck did not recover its former position for more than two hours. After long continued traffic this rate of return was somewhat slower, due probably to fatigue of materials.

Concrete surfaces were found to carry about 3,500,000 tons of traffic on solid rubber tires without abrasion.

THE ACTION OF CERTAIN BACTERIA ON THE NITROGENOUS MATERIAL OF SEWAGE, E. G. Birge. [Wisconsin University Studies in Science No. 2(1921), pp. 139-150.]

Preliminary studies conducted at the University of Wisconsin are reported, the purpose of which was to determine the chemical action of certain individual species of bacteria on sewage in pure cultures, singly or mixed. Those selected were *Bacillus coli, B. cloacae, B. pyocyaneus, B. vulgaris, B. mesentericus ruber,* and *B. subtilis.* They were selected because they represent aerobic types which are found frequently or constantly in sewage. The effects of these bacteria were studied in fresh sewage, filtered and sterilized by heat at 120 C. (15 pounds pressure) for forty-five minutes. They were also studied under aerobic and anaerobic conditions in pure and in mixed cultures. Particular attention was paid to the changes in free ammonia, organic nitrogen, nitrites, and nitrates.

Bacteriologically it was shown that *B. coli* was completely overgrown under anaerobic conditions in the 24-hour period. Under aerobic conditions it was able to overgrow *B. pyocyaneus,* but was overgrown by the rest of the bacteria studied. When grown in pure cultures, with the exception of *B. proteus,* the bacteria gave more constant results under aerobic than anaerobic conditions. *B. subtilis* showed a marked ammonifying power throughout the work under aerobic conditions. Under anaerobic conditions it regularly decreased the free ammonia and organic nitrogen content, increasing the nitrites and nitrates, especially the latter. *B. coli* and *B. cloacae* had a decided reducing action on both the nitrites and nitrates. Under some conditions, as yet undetermined, they reduced the free ammonia content also. *B. proteus* had a considerable ammonifying power under anaerobic conditions. This was very slight under aerobic conditions, and was more constant at room temperature than at 37.5 degrees Centimeter. The action of *B. pyocyaneus* and *B. mesentericus ruber* was irregular under both aerobic and anaerobic conditions.

The experiments with mixed cultures showed that the chemical changes followed very closely those of the predominant bacteria in pure culture. Those experiments which did not follow this rule, and in which there was a decided predominance of one microorganism, showed that the bacteria had become predominant too late in the incubation period to effect a chemical change. *B. coli* and *B. cloacae, B. coli,* and *B. proteus* gave more constant results when grown in mixed than when grown in pure cultures. These were the only instances of an apparently true symbiotic relationship. The results of the experiments in which more than two bacteria were grown in mixed culture showed that the incubation period, 24 hours, was too short to allow any one microorganism of any group of bacteria to establish itself chemically.

It is concluded that it is possible to predict the changes in the chemical composition of sewage if a group or species of bacteria is predominant, although the results so far are not considered sufficient to justify an attempt to control the bacterial flora of the septic tank.

PAINT PROTECTION FOR WOOD, C. T. Meyers. [*Mechanical Engineering* (New York), 44(1922), No. 8, pp. 519, 520, 545, figs. 2.]

Attention is drawn to the dearth of information as to the relative values of various kinds of paints and primers for the protection of wood against moisture, and a preliminary analysis of the subject and a summary of available information is given indicating the need for research on the subject. The importance of information on the durability and dimensional stabilization of painted articles is especially emphasized.

Tests made of small pieces of hickory, oak, birch, and maple measuring 1 by 1 by 1 inch, to obtain comparative data on the paints and primers on the market showed that paints of the ordinary brands and formulas were not effective as moisture-proofing agents even when three coats were applied. A preliminary test with a case in solution indicated that it has water-proofing qualities which for some classes of protection may be very valuable. The same was true of some of the pyroxalin compounds. Varnishes were in general found to be more effective than paints, but in the protection of wheels its application was not suitable for primary coats.

RECORDING DYNAMOMETER FOR TRACTORS, G. W. Watson. [*Engineering* (London), 113 (1922), No. 2948, pp. 814-816, figs. 10.]

A recording dynamometer for tractors, which has been used in English tractor trials, is described and diagrammatically illustrated. This dynamometer is said to give a continuous graphic record of the drawbar pull, the speed, and the depth of plowing.

CRANKCASE OIL DILUTION PROBLEM AND ITS SOLUTION, W. F. Parish. [*Journal of the Society of Automotive Engineers*, New York, 11(1922), No. 1, pp. 35-47; also in *Engineering World*, Chicago, 20(1922), No. 5, pp. 307-314, figs 11.]

This is an extended study of the effect of fuel dilution on the viscosity and consequently the efficiency of the lubricating oils in internal-combustion engines. The carbon-forming properties of oils and the effect of heavy oil upon engine efficiency are discussed. Although the dilution of the lubricant should be a minimum with one engine operating at full load on the dynamometer stand, results of engine tests extending over the last ten years show an increase in such dilution of from two to twelve per cent.

As a solution of the problem of crankcase dilution, the author offers a system for crankcase oil regeneration consisting of four main elements by which the fuel and water dilution are automatically removed and the sediment, composed of carbon particles, sand, and minute pieces of metal filtered out. The operation of this system, which it is claimed will not interfere with the present lubricating system of the engine and functions equally well with the splash and forced-feed systems, is described and illustrated. Charts showing the results obtained from comparative test runs with and without the system are also presented, indicating that its use practically eliminates crankcase dilution.

COLLOIDS AND SEWAGE DISPOSAL, F. W. Mohmlan and L. Pearse. [*Engineering World*, Chicago, 20(1922), No. 5, pp. 301-303.]

A summary of existing knowledge on the relation of colloid chemistry to tank treatment of sewage is presented, and methods of study and the determination of colloids and the results of processes for their removal are discussed.

It is concluded that there is a need for (1) a standard definition of the limits of size of colloids in sewage, (2) a standard method for the determination of sewage colloids, (3) study of the effect of the hydrogen-ion concentration on the removal of colloids, correlated with other determinations and observations which will prove the validity of such pH determination, (4) tests of the practical application of precipitants which have been found effective in laboratory experiments, and (5) investigation of the principle governing the retention of moisture by sewage sludge.

It is stated that as yet in the removal of colloids by tank treatment but little has been accomplished in a practical way by settling alone or by the use of colloidors. Chemical precipitation by alkaline precipitants removes some of the colloidal matter, but adds so much to the bulk of the sludge that the use of the process is restricted.

The use of acids yields a well clarified effluent in many cases without the large bulk of sludge, but has not proved applicable except under special conditions. Activated sludge is said to be effective in removing colloids, but can not be classed under tank treatment.

IRRIGATION IN NORTHERN COLORADO, R. G. Hemphill. [U. S. Department Agriculture Bulletin 1206(1922), pp. 85, pls. 24, figs. 16.]

The results of an irrigation investigation carried on for a number of years in the valley of the Cache la Poudre River in northern Colorado by the U. S. Department of Agriculture, in cooperation with the Colorado Experiment Station, are presented in this report.

The characteristics of the climate of the valley are a light rainfall, a wide range in daily and seasonal temperature, low relative humidity, moderately high wind movement, and a comparatively low rate of evaporation.

The prevailing type of soil is a light sandy loam which is generally well drained. The average depth of water applied for an irrigation is close to 0.75 feet but the average is raised somewhat by the heavier irrigations when a direct flow of water is available in order to reduce the later requirements of stored water.

The water supply of the valley averages 464,000 acre-feet, which includes 340,000 acre-feet of normal run-off in the river and its tributaries, 35,000 acre-feet of foreign water, 5,000 acre-feet pumped from wells and available seepage return to the amount of 84,000 acre-feet. Practically the whole supply is said to be used. The total seepage return in the valley is 137,000 acre-feet. The topography is such that a large proportion of this seepage return is available for use. Drainage is not a serious problem in the valley. In the aggregate, canal capacities exceed their appropriations by ten per cent. Almost without exception distribution from the river is made in accordance with decreed priorities.

The duty of water for the river as a whole is 1.67 acre-feet per acre. The consumptive duty for the valley is estimated not to exceed 1.25 acre-feet per acre. The area actually irrigated in the valley proper in 1917 was 225,700 acres. The majority of the canals of the valley are cooperative enterprises. The absorption loss in the canals of the valley between the head gate and the farm lateral is estimated to average ten per cent of the supply.

Furrow irrigation and flooding from field laterals are the only methods of irrigation practiced. Best results are said to be obtained by a fast irrigation to a depth of from 0.4 to 0.6 feet. The run-off from the lower end of the field is estimated to average six per cent of the amount applied. The average number of irrigations applied on the fields under investigation ranged from 1.21 for wheat to 3.79 for potatoes. The average duty in acre-feet per acre, measured at the head of the farm lateral, was found to be 2.57 for alfalfa, 1.04 for wheat, 1.35 for oats, 1.19 for barley, 1.86 for sugar beets, 2.2 for potatoes, and 0.69 for beans.

Considerable information regarding structural features is also included.

A. S. A. E. and Related Activities

Personals

ELWOOD MEAD, elected an honorary member of the American Society of Agricultural Engineers this year, is probably America's greatest authority on reclamation. He has always been first to recognize the necessity of irrigation in agriculture and to plan and carry out development work in irrigation in the arid states. He was professor of irrigation engineering in the Colorado Agricultural College from 1883 to 1888. During the next ten years as state engineer of Wyoming he developed the Wyoming irrigation laws which were copied by a dozen other states. From 1898 to 1907 he was chief of irrigation investigations of the U. S. Department of Agriculture, and was professor of irrigation institutions at the University of California. From 1907 to 1915 he was chairman of the State Water Commission of Victoria, Australia.

ELWOOD MEAD

Several years ago he took personal charge of work to inaugurate a planned rural development in California, out of which have grown the two colonies of Durham and Delhi which are splendid examples of what can be done to help men own farms, to help large landholders in a profitable subdivision and sale of their properties and to establish a loyal and permanent citizenship where lonely prairies are annually grown to unprofitable grain crops.

Dr. Mead is now professor of rural institutions in the University of California and chief of the state land settlement division of the Department of Public Works in California. He was born and raised on a farm near Patriot, Indiana, receiving his first degree in civil engineering from Purdue in 1882. He was given the professional degree of civil engineer by Iowa State College in 1883, and received the distinct honor of doctor of engineering granted by Purdue in 1904.

G. N. ALLEN, general superintendent of the Walter A. Wood, Mowing and Reaping Machine Company, recently completed an extended trip through England, Belgium, France, Switzerland and Italy where he conducted a careful study of the outlook for the sale of agricultural implements.

FRANK P. HANSON has severed his connection with the cement products bureau of the Portland Cement Association, and is now in charge of farm mechanics extension at the University of Illinois.

GUY A. HART is now located at the Alabama Polytechnic Institute in connection with an arrangement whereby the U. S. Bureau of Public Roads agreed to place a drainage engineer at that institution. Mr. Hart has had extensive experience in drainage work throughout the west and south and will have charge of research work in drainage and terracing, and also extension and development work along these lines.

LESLIE E. HAZEN, professor of rural engineering at the Oklahoma Agricultural and Mechanical College, being asked by the editor for news of himself writes, "I have neither been hired nor fired, discouraged nor encouraged, abused nor misused, browbeaten nor frightened. I am so terribly busy I could not blow a horn if I had one. I am instituting about three new subjects, rooting for a new building, trying to fix up an old one, seeking for funds, and attempting to put agricultural engineering on the first page of the annals of this school."

J. B. KELLEY, professor of agricultural engineering at the University of Kentucky, reports considerable progress in development of agricultural engineering in that state. Prof. Kelley has been connected with that institution for three years and since that time has made a great deal of progress in building up the college and extension work in agricultural engineering. Last year they erected a new laboratory building to take care of tractors, farm machinery, and shop work. In extension work they have been very busy preparing farm building plans and circulars for general distribution. In extension work they are at present emphasizing drainage, terracing, and farm sanitation.

GEORGE S. KNAPP, state irrigation commissioner of Kansas, is working on an agreement with officials of the State of Colorado, the purpose of which is to provide for the division and control of the Arkansas River between the water users of both states to the end of the intermittent litigation of the past twenty years beween appropriators in the two states may be brought to an end and the Kansas ditches assured of an adequate supply of water. The possibility of reservoir storage of winter flow and flood waters, through cooperation between the two states, is receiving particular attention.

E. W. LEHMANN, professor of farm mechanics at the University of Illinois, is co-author with Prof. Fred D. Crawshaw of a new book covering the subject of farm mechanics which is being published by the Manual Arts Press of Peoria. This book was prepared primarily for use in vocational agricultural high schools, but it is also of value as a reference book for county farm advisers and of special value to the farmer in the solution of many of his engineering problems.

J. T. MCALISTER, assistant professor of farm machinery of The Clemson Agricultural College, South Carolina, reports that terracing in the Piedmont section of the State of South Carolina is the outstanding agricultural engineering problem with which he is concerned in his work. Another activity which he will undertake is the organization of agricultural engineering extension in that state. He points out that The Clemson Agricultural College and the University of Tennessee are the only two southern state agricultural colleges that have not yet separate and distinct departments of agricultural engineering. He is making a special effort to get agricultural engineering established in a separate department at the institution with which he is now connected.

FRANK A. MECKEL, agricultural engineering editor of the Capper farm publications for the past two years, has made substantial progress during that time in building up the agricultural engineering department of those publications. Recently he completed a very interesting and significant investigation relative to the price situation with respect to tractors and farm implements. Data on the prewar, peak, and present prices of tractors and implements from leading manufacturers were procured and compiled for purposes of comparison. The figures were then made available to readers of Capper publications and manufacturers, and while results showed that prices were still higher than in 1913, it also showed that a great deal of the complaint as to high prices was not justified, and the investigation had the effect of stopping much of this complaint.

H. E. MURDOCK, professor of agricultural engineering at the University of Montana, reports that they now have a full-fledged department of agricultural engineering at that institution. The agricultural engineering section of the Montana agricultural experiment station functioned seven years before the college authorities decided to add educational work in agricultural engineering. At the present time, in addition to Prof. Murdock, the staff of instructors in agricultural engineering consists of R. M. Merrill, a graduate of Iowa State College, in charge of tractors and other farm motors and machinery work; G. R. Barker, of Utah, in charge of irrigation and drainage, and F. L. Griffin in charge of farm shop work. Last year Blaine Ferguson, of Oregon, was secured as extension specialist in irrigation. Prof. Murdock is devoting considerable time to the Montana Irrigation and Drainage Institute, endeavoring to create greater interest in irrigation for the state.

M. L. NICHOLS, professor of agricultural engineering, Alabama Polytechnic Institute, reports that cooperative agreements have been entered into with the U. S. Bureau of Public Roads whereby a drainage engineer will be placed at that institution. The land clearing work at the Alabama Polytechnic Institute will also be conducted in cooperation with the U. S. Bureau of Public Roads in the future. With the uniting of these forces a rather extensive project of investigation is being outlined. With the cooperative movement of farmers in the South there have been numerous requests of the agricultural engineers for investigation and design of various plants for handling agricultural commodities. Work has been under way for the last year in the department of agricultural engineering in cooperation with chemists at the Alabama station and with Dr. Paine in charge of the carbohydrates laboratory of the U. S. D. A. along the line of designing syrup standardization plants.

H. E. ORR was recently placed in charge of advertising of the Cleveland Tractor Company to succeed E. B. Stone, resigned. Mr. Orr has been connected with the company for several years handling sales and contract work at the home office. He will take charge of the advertising in addition to his other duties.

RALPH L. PATTY, extension specialist in agricultural engineering at the South Dakota State College, recently in connection with his work put on an exhibit at the Mitchell Corn Palace, South Dakota, showing a small modern house with bathroom and kitchen equipment with sewage connections, and also a small model of septic tank for farm or private home, which he installed behind plate glass so that the cross section could be seen clearly. During the week this exhibit was on display explanation was made and plans for constructing the tank was furnished to 2100 people.

JOHN W. RANDOLPH, associate professor of agricultural engineering at the Alabama Polytechnic Institute, in charge of farm motors work, was married in August to Miss Orlean Moore, of Union Springs, Alabama.

C. O. REED has become associated with the agricultural engineering department of the Ohio State University as associate professor in charge of field machinery. Mr. Reed was formerly connected with the farm mechanics department of the University of Illinois in a similar capacity. In 1917 he joined the George Batten Advertising Agency, as agricultural representative, and when the Samson Tractor Company was formed he became advertising manager of that organization. Later he was placed in charge of research work and about a year ago was promoted to divisional sales manager.

L. J. SMITH, professor of agricultural engineering at the State College of Washington, is co-author with F. D. Heald of a bulletin recently issued by that institution entitled "The Dusting of Wheat for Bunt or Stinking Smut." A large part of the bulletin deals with the W. S. C. smut-treating machine designed and built by the agricultural engineering department under the direction of Prof. Smith.

Annual Meeting in St. Louis

THE sixteenth annual meeting of the American Society of Agricultural Engineers will be held at St. Louis, Missouri, December 27, 28, and 29, 1922. The Implement, Vehicle, and Hardware Association of St. Louis, which extended a very cordial invitation to the Society to hold the annual meeting there, has appointed a committee to cooperate in making the annual meeting this year a success. The meeting promises to be the most successful that has ever been held. An excellent program is being worked up and the plans being made for handling the meeting give assurance of the largest and most constructive meeting in the history of the Society. The fact that St. Louis is, from a geographical standpoint, almost in the center of the United States, it is anticipated that a large number of agricultural engineers from all over the country, and particularly from the South, will be in attendance.

Wanted—Correct Addresses of These A. S. A. E. Members

NOTE: Mail is being returned from the addresses given below. These members, or others who know of their whereabouts, are requested to send the Secretary their correct addresses at once. Inasmuch as delivery cannot now be made, AGRICULTURAL ENGINEERING will not be mailed until correct addresses are received.

George J. Baker, 112 Theodore Street, Detroit, Michigan.

Nelson C. Beem, Carey, Ohio.

Cyrus F. Breeden, Marshalltown, Ohio.

Claude S. Bristow, Elks Club, Portland, Oregon.

R. D. Chapman, 1336 Woodward Ave., Detroit, Mich.

George Collins, 461 Market Street, San Francisco, California.

George M. Duncomb, 136 S. Harvey Ave., Oak Park, Illinois.

J. C. Elliff, Box 115, Little Rock, Arkansas.

D. M. Emery, Illinois Hotel, Bloomington, Illinois.

Francis K. Flynn, 1540 Broadway, New York City.

H. A. Hatfield, Bank of Hamilton, Toronto, Ontario, Canada.

K. D. Hequembourg, 531 West 112th Street, New York.

J. A. Howenstine, 1566 North High Street, Columbus, Ohio.

W. R. Killinger, 108 S. Franklin Ave., Riverside, Illinois.

A. M. Leoni, 3832 Reisterstown Road, Baltimore, M. D.

M. W. McDonald, Charleston, West Virginia.

John T. Montgomery, Bliss, Oklahoma.

Dent Parrett, Chicago Heights, Illinois.

Arthur H. Pearsoll, 1350 Rosedale Avenue, Chicago, Illinois.

John Howard Rees, 2211 Commerce Building, Columbus, Ohio.

Jose Rivera, Matamoros 23, Mexico City, Mexico.
W. K. Runyan, 187 Peachtree Street, Atlanta, Georgia.
George W. Rynders, Box 127, Bradley, Illinois.
Lee Stewart, Spooner, Wisconsin.
Oscar Van Pelt Stout, 361 Fraternith Building, Lincoln, Nebraska.
J. H. Stowell, 3500 Colfax Ave., South, Minneapolis, Minnesota.
S. Y. Sweeney, 111 E. Campbell Ave., Roanoke, Virginia.
A. C. Todd, Moline Tractor Works, Rock Island, Ill.
T. A. Toenjes, 1115 South Street, Waterloo, Iowa.
H. L. Waterman, 428 Green Street, Rockford, Illinois.
J. C. Weidrich, c/o Dempsey Hotel, Davenport, Iowa.
George G. Whitfield, Demopolis, Alabama.
A. A. Wolf, Y. M. C. A., Omaha, Nebraska.

Applicants for Membership

The following is a list of applicants for membership received since the publication of the September issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to the applicants for the consideration of the Council prior to election.

Wabun Clarence Kreuger, department of farm mechanics, University of Tennessee, Knoxville, Tennessee.

Otto C. Tretten, 785 Market Street, San Francisco, California.

FOR TRANSFER OF MEMBERSHIP GRADE

John Franklin Beyerle, Bernville, Pennsylvania.
W. A. Crumley, Xenia, Ohio.
Fred C. Eggers, 313 W. Burlington Street, Fairfield, Iowa.
Frank P. Hanson, Department of Farm Mechanics, University of Illinois, Urbana, Illinois.
Verne W. Stambaugh, Department of Agricultural Engineering, Iowa State College, Ames, Iowa.

EMPLOYMENT SERVICE

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members, as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

The Secretary receives at frequent intervals bulletins from the Engineering Societies' Service Bureau, 29 West 39th Street, New York City, listing the "positions open" as reported by member societies. Copies of these bulletins are sent to the "men available" listed below, as soon as received.

Men Available

AGRICULTURAL ENGINEER wants position as experimental agricultural engineer or with some agricultural publication. Graduate, 1918, agricultural college of the University of Illinois. Was editor of the Illinois agricultural students publication in his senior year. For two years employed by an explosives manufacturer as agricultural sales and service man for the State of Wisconsin. At present associated with the land clearing department of the University of Wisconsin. Age 25, married, American. MA-101

MECHANICAL AND ELECTRICAL ENGINEER, graduate of Cornell University and Armour Institute, with nineteen years of practical experience in designing, manufacturing, and marketing gasoline engines, automobiles, motor trucks and tractors, having specialized particularly on internal-combustion motors and their application, prefers mechanical work cooperating with the different manufacturing and sales departments along the lines of sales engineering, or other work into which his qualifications would fit. MA-104

AGRICULTURAL ENGINEER wants position in southwest. Graduate of University of Illinois 1915, five years practical experience on Illinois farm with power equipment, two years in charge of the agricultural engineering department New Mexico College of Agriculture; considerable garage experience and service experience on unit power and light plants. Also one summer in Philadelphia battery service station. MA-106

AGRICULTURAL ENGINEER, graduate in mechanical engineering at Michigan Agricultural College, desires position teaching all kinds of farm machinery or automotive work, or with some farm-equipment manufacturer. Will be available April 1, 1922. Has served one year as instructor in tractors and trucks, and one year conducting service schools for a leading tractor manufacturer. Can furnish best of references. MA-110

AGRICULTURAL ENGINEER, graduate of Iowa State College 1920, with several years of practical experience farming with machinery and one year's teaching experience in high school, wants employment on a large farm or in college teaching of power farming. Twenty-five years of age. Married. MA-111

AGRICULTURAL ENGINEER, graduating from University of Missouri at the end of present semester (available January 1, 1923), would like position teaching agricultural engineering work or with some company manufacturing farm equipment. Age 23. Unmarried. MA-115

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